an active layer made of semiconductor;

a ridge stripe having a cladding layer formed on said active layer and a contact layer formed on the cladding layer to protrude from said active layer;

Cont A'

a pair of gratings each having a periodic structure in a longitudinal direction of the ridge stripe having a plurality of grooves each extending from side walls of the ridge stripe on flat portions in both sides of the ridge stripe; and

absorbing layers including metal which are formed on the gratings to cover the surfaces of the grooves of gratings to absorb excited light.

REMARKS

In the office action the Examiner rejected claims 1 and 4-7 as anticipated under 35 U.S.C. 102 and claims 1 and 4 under 35 U.S.C. 103 as unpatentable for the following reasons.

(1) Claims 1 and 4-7 are rejected under 35 U.S.C. 102(b) as being anticipated by Chen et al.(USP 5,982,804).

(2) Claim 1 is rejected under 35 U.S.C. 103(a) as being unpatentable over Fiddyment et al. (USP 4,805,184) in view of C.H. Chen et al (Electronics Letters 4th July 1996 Vol. 32 No. 14, pp. 1288-1290) (hereinafter, C.H. Chen's article). Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Fiddyment et al. in view of Chen et al., and further in view of Stegmuuller (USP 4,761,791).

Claims 2 and 3 are objected to as being dependent upon a rejected base claim, but contain allowable subject matter. Favorable reconsideration and allowance of the present application are respectfully requested in view of the amendment to claim 1 and for the following reasons.

The Applicant has amended claim 1 for clarity, but no new matter is introduced as a result of this amendment.

The feature of claimed invention in the amended claim 1 is the fact that, in a semiconductor laser of laterally-coupled distributed feedback type, the absorbing layers including metal are formed on the gratings to cover the surfaces of the grooves of gratings to absorb excited light. This feature is supported by line 4 on page 6 and the sequent in the specification, and Figs. 2, 3 and 4, as similarly to claims 2 and 3. For example, the claimed invention in the amended claim 1 includes a laterally-coupled DFB ridge semiconductor laser as shown in Fig. 2 which comprises an active layer made of semiconductor 10; a ridge stripe 15; a pair of gratings 20; and absorbing layers 40 including a metal layer 40b (see Fig. 3) covering the gratings 20. It should be noted that the absorbing layer and the grating are individual each other.

1) Claim rejection under 35 U.S.C. 102(b)

There is no description of any absorbing layer including metal and covering the surfaces of the grooves of gratings to absorb excited light in the Chen et al. reference. The Examiner has asserted that Chen et al. teaches a semiconductor laser comprising pair of gratings "said pair of gratings being periodic variations of the index of refraction (cf. column 5,

lines 14-15) and hence, according to the Kramers-Kronig relations, periodic variations of absortion, hence having absorbing layers covering the surfaces of the grooves of gratings to absorb excited light" (the 2nd paragraph on page 3 of the Office Action). In other words, the grating in the Chen et al. device has an absorptive component. This is not equivalent to the grating having absorbing layers. In fact, the Chen et al. semiconductor laser is not provided with any absorbing layer including metal formed on the gratings to cover the gratings. In addition, Chen et al. fails to teach the Kramers-Kronig relations and even the relationship between the periodic variations of the refractive index and the periodic variations of absorption. There is a jump in the Examiner's logic in that Chen et al. teaches absorbing layers covering the surfaces of the grooves of gratings to absorb excited light. It is incorrect to jump to existence of absorbing layers on the basis of just one example such as the Kramers-Kronig relation.

The absorptive component of the grating in the Chen et al. device has an insignificant effect to absorb excited light. With respect to the Bragg gratings, a change in the refractive index due to a grating is associated with the change in absorption through the Kramers-Kronig relation. For example, the change in the refractive index Δn_{eff} may be expressed as

$$\Delta n_{eff}(\lambda) = \frac{1}{2\Pi^2} P\int_0^\infty \frac{\Delta\alpha_{eff}(\lambda)}{1-(\lambda / \lambda')^2} d\lambda$$

where P is the principle part of the intergral, λ is the wavelength, $\Delta\alpha_{eff}$ is the effective change in absorption coefficient and λ' is the wavelength for which the refractive

index is calculated [Andreas Othonos and Kyriacos Kalli "Fiber Bragg Gratings" Artech House Publishers p60]. Even if an amount of absorption is calculated on the basis of the above equation of the Kramers-Kronig relation, the resultant will be only a negligibly small value insufficient for any absorbing layer. Anyway, Chen et al. does not teach the Kramers-Kronig relation nor any absorbing layer.

As seen from the reason set forth above, Chen et al. does not render claim 1 and dependent claims thereof anticipated and unpatentable. Accordingly the Applicant respectfully requests withdrawal of Chen et al. and the above 102(b) rejection.

2) Claim rejections under 35 U.S.C. 103(a)

Claim 1 is rejected under 35 U.S.C. 103(a) as being unpatentable over Fiddyment et al. in view of C.H. Chen's article.

Fiddyment et al. discloses a ridge waveguide semiconductor laser device comprising a base semiconductor portion and first and second elevated semiconductor portions separated by a channel, the first elevated semiconductor portion constituting the ridge.

However, Fiddyment et al. fails to disclose any absorbing layer including metal formed on the gratings to cover the gratings to absorb excited light, as similar to Chen et al. mentioned above.

In addition, Fiddyment et al. discloses that "layer 5 was corrugated by chemical etching through an electron-beam-exposed resist mask...The distributed feedback corrugations 6" (column 5, lines 46-50) and "then corrugated layer 5 was overgrown with a layer 7 Zn-doped (p-type) indium phosphide by atmospheric

pressure metal organic chemical vapour deposition (MOCVD)" (column 5, lines 57-60). As seen from these descriptions, the Fiddyment et al. device has a grating beneath the ridge stripe of waveguide. The Fiddyment et al. device is not a laterally-coupled DFB ridge semiconductor laser in which there is no grating beneath the ridge stripe as claimed device in claim 7.

C.H. Chen's article discloses coupling coefficients in a gain-coupled distributed feedback laser device with an absorptive grating.

However, C.H. Chen's article fails to disclose any absorbing layer including metal formed on the grating to cover the gratings to absorb excited light, as similar to Chen et al. and Fiddyment et al. mentioned above, though it reports to provide the absorptive grating with periodic variation of the absorption coefficient to implement the index and loss-coupling mechanism in the DFB laser device. In addition, C.H. Chen's article does not teach nor suggest every feature of claim 1.

There is no motivation in both Fiddyment et al. and C.H. Chen's article to cover the surfaces of the grooves of the gratings with material including metal that absorbs light of the wavelength excited by the laser.

Accordingly, withdrawal of Fiddyment et al. and C.H. Chen's article to claim 1 under 35 U.S.C. 103(a) is respectfully requested.

Furthermore, claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Fiddyment et al. in view of Chen et al., and further in view of Stegmuuller.

First, a semiconductor laser according to claim 4, as shown in Figs. 2 and 9, comprises bracket grating portions 20a. The bracket grating portion 20a has a slope surface extending from a flat top portion of the ridge stripe 15 to a top face of a land portion defined by the adjacent grooves and coupling the side walls of the ridge stripe and the gratings. The bracket grating portions 20a are formed by performing a two step etching process consisting of dry and wet etchings. The depth between the adjacent bracket grating portions 20a is defined so deep that a high optical coupling coefficient between the grating and guided light in the ridge stripe is achieved. See <4. Fabrication of grating> in line 24 on page 9 through line 8 on page 11 of the specification.

Stegmuuller discloses a metal-clad ridge waveguide laser diode which has a grating or discontinuity structure formed laterally of the ridge and possibly over the ridge along the laser active region. The discontinuity structure is formed, as shown in Fig. 2, to have individual incisions 122 each having the same depth uniformly.

Therefore, Stegmuuller fails to disclose any bracket grating portion as provided in the present invention.

There is no motivation in Stegmuuller, Fiddyment et al. and C.H. Chen's article to cover the gratings with material including metal while providing bracket grating portions onto the grating.

Accordingly, withdrawal of Stegmuuller, Fiddyment et al. and C.H. Chen's article to claim 4 under 35 U.S.C. 103(a) is respectfully requested.

Applicant asserts that the amended claims entirely differ from the conventional arts appearing in those cited references, and are not obvious to one of ordinary skill in the art. We respectfully request reconsideration and allowance of the present application. Reconsideration of the objection to claims 2 and 3 as being dependent upon rejected base claim 1 is requested in view of the amendment to claim 1 and the remarks above which Applicant asserts make claim 1 allowable.

For all of the foregoing reasons, it is respectfully submitted that all of the claims now present in the application are clearly novel and patentable over the prior art of record, and are in proper form for allowance. Accordingly, favorable reconsideration and allowance is respectfully requested. Should any unresolved issues remain, the Examiner is invited to call Applicants' attorney at the telephone number indicated below.

A check in the amount of $110 is enclosed for a one month extension of time. The Commissioner is hereby authorized to charge payment for any fees associated with this communication or credit any over payment to Deposit Account No. 16-1350.

Respectfully submitted,

John J. Goodwin
Reg. No. 20,050

Date January 24, 2003

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CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service on the date indicated below as first class mail in an envelope addressed to the Commissioner of Patents, Washington, D.C. 20231.

Date: 1/24/03

Signature: Carolina Rodriguez
Person Making Deposit

Marked Up Claim

1. (Amended) A semiconductor laser comprising:

an active layer made of semiconductor;

a ridge stripe having a cladding layer formed on said active layer and a contact layer formed on the cladding layer to protrude from said active layer;

a pair of gratings each having a periodic structure in a longitudinal direction of the ridge stripe having a plurality of grooves each extending from side walls of the ridge stripe on flat portions in both sides of the ridge stripe; and

absorbing layers [covering] <u>including metal which are formed on the gratings to cover</u> the surfaces of the grooves of gratings to absorb excited light.